

# Image Super-Resolution via Iterative Refinement

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## Abstract

We present SR3, an approach to image Super-Resolution via Repeated Refinement. SR3 adapts denoising diffusion probabilistic models (Ho et al. 2020), (Sohl-Dickstein et al. 2015) to image-to-image translation, and performs super-resolution through a stochastic iterative denoising process. Output images are initialized with pure Gaussian noise and iteratively refined using a U-Net architecture that is trained on denoising at various noise levels, conditioned on a low-resolution input image. SR3 exhibits strong performance on super-resolution tasks at different magnification factors, on faces and natural images. We conduct human evaluation on a standard 8× face super-resolution task on CelebA-HQ for which SR3 achieves a fool rate close to 50%, suggesting photo-realistic outputs, while GAN baselines do not exceed a fool rate of 34%. We evaluate SR3 on a 4× super-resolution task on ImageNet, where SR3 outperforms baselines in human evaluation and classification accuracy of a ResNet-50 classifier trained on high-resolution images. We further show the effectiveness of SR3 in cascaded image generation, where a generative model is chained with super-resolution models to synthesize high-resolution images with competitive FID scores on the class-conditional 256×256 ImageNet generation challenge.